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DEVELOPING A NEW PUBLIC AUDIT PARADIGM IN THE AGE OF TECHNOLOGICAL CHANGE

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Abstract. The development of society in Kazakhstan and the emergence of new challenges for the state require a transformation of the public management system. The experience of developed countries highlights the central role of auditing as an independent mechanism for controlling public finances. Such a system is essential for objectively evaluating current financial management practices and identifying ways to improve them. As Kazakhstan's economy evolves, new demands are placed on financial resource management, prompting changes in tax and budget systems. In this context, modern approaches to budget policy directly influence the development of state audit practices. Technological progress has greatly impacted the work of Supreme Audit Institutions (SAIs). New digital technologies are already transforming auditing practices and are expected to further enhance the efficiency of public financial oversight. However, SAIs differ in how they adopt and apply technology, as they are at various stages of digital transformation. Their effectiveness often depends on factors such as the digital maturity of audited entities, access to data, and available resources. When audited organizations lack modern digital systems, it becomes challenging for SAIs to conduct thorough data analysis. The article provides a conceptual framework for the development of a new paradigm of public audit in the context of technological transformation and digital governance. The study highlights the transition from traditional financial control to strategic assessment of national resources, including natural assets, supported by digital tools. Based on the analysis of international models and the national context of Kazakhstan, the authors propose the key elements of a new paradigm that combines efficiency, transparency and digitalization of public audit. The article highlights the importance of assessing the effectiveness of using national resources as part of modern audit functions.

Keywords: paradigm, state audit, new technologies, supreme audit institutions, data arrays, software

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ТЕХНОЛОГИЯЛЫҚ ҚАЙТА ҚҰРУ ЖАҒДАЙЫНДА МЕМЛЕКЕТТІК АУДИТТІҢ ЖАҢА ПАРАДИГМАСЫН ӘЗІРЛЕУ ҚАЖЕТТІЛІГІ

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Аннотация. Қазақстандағы қоғамның дамуы және мемлекет үшін жаңа міндеттер басқару жүйесін жаңартуды талап етеді. Дамыған елдердің тәжірибесі аудиттің мемлекеттік қаржыны тәуелсіз бақылауда шешуші рөл атқаратынын көрсетеді. Мұндай механизм ағымдағы қаржылық басқаруды объективті бағалау және оны жақсарту жолдарын іздеу үшін қажет. Елдің экономикалық дамуы жағдайында қаржы ресурстарын басқаруға жаңа талаптар туындайды, бұл салық және бюджеттік жүйелердегі өзгерістерге әкеледі. Осыған байланысты мемлекеттік аудит бағытына тікелей әсер ететін бюджет саясатына заманауи тәсілдер әзірленуде. Техникалық прогресс жоғары қаржылық бақылау органдарының (ЖҚБО) жұмысын айтарлықтай өзгертті. Жаңа технологиялар аудитке әсер етті және болашақта жұмыс әдістерін одан әрі өзгертіп, мемлекеттік қаржыны басқарудың тиімділігін арттыруы мүмкін. Әрбір ЖҚБО технологияны әртүрлі тәсілдермен

пайдаланады, өйткені олар цифрлық трансформацияның әртүрлі кезеңдерінде. Олардың мүмкіндіктері Мемлекеттік органдардың цифрландыру деңгейі, деректерге қол жетімділік және қаржылық ресурстар сияқты әртүрлі факторларға байланысты. Мысалы, аудиторлар тексеретін мемлекеттік ұйымдар заманауи цифрлық жүйелерді пайдаланбаса, бұл деректерді тиімді талдау үшін ЖҚБО мүмкіндіктерін шектейді. Мақалада технологиялық трансформациялар мен цифрлық басқару контекстінде мемлекеттік аудиттің жаңа парадигмасын әзірлеудің тұжырымдамалық негізі келтірілген. Зерттеу цифрлық құралдардың қолдауымен дәстүрлі қаржылық бақылаудан Ұлттық ресурстарды, соның ішінде табиғи активтерді стратегиялық бағалауға көшуді көрсетеді. Қазақстанның халықаралық модельдері мен ұлттық контекстін талдау негізінде авторлар мемлекеттік аудиттің тиімділігін, ашықтығын және цифрландырылуын біріктіретін жаңа парадигманың негізгі элементтерін ұсынады. Мақалада қазіргі аудиторлық функциялардың бөлігі ретінде Ұлттық ресурстарды пайдалану тиімділігін бағалаудың маңыздылығы көрсетілген.

Түйін сөздер: парадигма, мемлекеттік аудит, жаңа технологиялар, жоғары аудит органдары, деректер массивтері, бағдарламалық қамтамасыз ету

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НЕОБХОДИМОСТЬ РАЗРАБОТКИ НОВОЙ ПАРАДИГМЫ ГОСУДАРСТВЕННОГО АУДИТА В УСЛОВИЯХ ТЕХНОЛОГИЧЕСКИХ ПРЕОБРАЗОВАНИЙ

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Аннотация. Развитие общества в Казахстане и новые задачи для государства требуют обновления системы управления. Опыт развитых стран показывает, что аудит играет ключевую роль в независимом контроле государственных финансов. Такой механизм необходим для объективной оценки текущего управления финансами и поиска путей его улучшения. В условиях экономического развития страны возникают новые требования к управлению финансовыми ресурсами, что влечет за собой изменения в налоговой и бюджетной системах. В связи с этим разрабатываются современные подходы к бюджетной политике, которые напрямую влияют на направление государственного аудита. Технический прогресс значительно изменил работу высших органов финансового контроля (ВОФК). Новые технологии уже повлияли на аудит, а в будущем могут еще больше изменить методы работы и повысить эффективность управления государственными финансами. Каждый ВОФК использует технологии по-разному, поскольку находятся на разных этапах цифровой трансформации. Их возможности зависят от различных факторов, таких как уровень цифровизации государственных учреждений, доступ к данным и финансовые ресурсы. Например, если государственные организации, которые проверяют аудиторы, не используют современные цифровые системы, это ограничивает возможности ВОФК для эффективного анализа данных. В статье представлена концептуальная основа для разработки новой парадигмы государственного аудита в контексте технологических преобразований и цифрового управления. В исследовании подчеркивается переход от традиционного финансового контроля к стратегической оценке национальных ресурсов, включая природные активы, при поддержке цифровых инструментов. Основываясь на анализе международных моделей и национального контекста Казахстана, авторы предлагают ключевые элементы новой парадигмы, которая объединяет эффективность, прозрачность и цифровизацию государственного аудита. В статье подчеркивается важность оценки эффективности использования национальных ресурсов как части современных аудиторских функций.

Ключевые слова: парадигма, государственный аудит, новые технологии, высшие органы аудита, массивы данных, программное обеспечение

Introduction

State audit is an important part of the management system and is an independent assessment of the work of government organizations. Its main task is to verify the effectiveness of the use of budgetary funds and ensure transparency of financial processes. The full implementation of public audit plays a key role in improving control over the expenditure of public funds. This helps to identify deficiencies in financial management, increase the responsibility of government agencies and ensure the rational use of the budget. The purpose of the scientific article is the need to develop a new paradigm of state audit in the context of technological transformations in the Republic of Kazakhstan. This article examines public sector auditing through the lens of various management approaches: traditional public administration, New Public Management Model (NPM), and network-based public administration (NPG). It is noted that the development of the audit methodology and standards of the European Court of Auditors (ECA) has led to improvements in the audit process over time.

In recent years, the ECA has shifted its focus to financial efficiency, paying more attention to assessing the effectiveness, cost-effectiveness and efficiency of using the European Union (EU) resources. In addition, performance auditing now covers not only financial aspects, but also issues such as sustainable development, ecology, governance, transparency, rule of law, combating fraud and corruption, as well as social aspects. This approach is consistent with the NPG concept, which views transparency as an important societal value (Grossi et al., 2023; Taiwo, 2016). In the context of rapid technological advancement and economic transformation, traditional approaches to public audit are no longer sufficient to address the complexity of managing public resources. Kazakhstan, like many other countries, is undergoing reforms in public financial management, which include a reassessment of the role and scope of public audit. This article seeks to define the contours of a new public audit paradigm that reflects the challenges of the digital age and the strategic importance of national resources.

Materials and methods

Auditors are increasingly using data visualization technologies, as this helps not only to visually present audit results to stakeholders, but also to effectively analyze large amounts of information. For these purposes, the SAIs actively use various software tools such as Power BI, Tableau and Infogram, as well as Python-based platforms, including Plotly and Matplotlib. These technologies allow you to create interactive graphs, charts, and dashboards, simplifying the perception of complex data. As part of the research, we conducted an analysis of the use of these tools in auditing activities.

Results and discussion

ECA, the main financial audit body of EU, is undergoing significant changes, adapting to modern challenges. Such challenges include climate change, respect for the rule of law, and ensuring the sustainability of the EU's social system (Wolff and Ladi, 2020; Nguyen, 2023). In addition, the work of the ECA is influenced by digital transformation, which is changing audit methods and requires the introduction of new approaches to the analysis of public finances. Previously, the activities of the ECA were based on the principles of NPM, which focuses on efficiency and market mechanisms in the management of public finances. However, in recent years, the Chamber has shifted its focus to a value-based approach consistent with the concept of NPG (Osborne, 2006; Almqvist et al., 2013; Carry, 2024). This approach highlights the importance of transparency, public engagement, and consideration of non-financial factors such as environmental sustainability, social responsibility, and anti-corruption measures.

This article examines the development of efficiency auditing and non-financial auditing in the public sector. Particular attention is paid to the transformation of auditing methods in supranational institutions such as the ESP. Thus, the material fills an existing gap in the scientific literature on supranational auditing and its impact on EU financial management (Bonollo, 2019; Mattei et al., 2021; Nerantzidis et al., 2022; Roberts, 2023). The events of recent years have shown that blindly following global trends in auditing no longer brings the expected results, as international auditing is experiencing a crisis. It is obvious that the traditional approach to auditing no longer meets the requirements of the modern economy and needs to be reviewed. This opens up opportunities for the professional auditing community in Kazakhstan to develop and implement a new, more effective audit concept that takes into account the specifics of the national economy and modern challenges.

Auditing is becoming more and more in demand, but in order for it to remain useful, it needs to be reviewed taking into account changes in the economy. Previously, the audit was mainly aimed at verifying financial statements, but now the requirements for it have significantly expanded. Companies, investors, and government agencies expect auditors not only to confirm the figures, but also to assess risks, management effectiveness, and the business' impact on the environment and society. Historically, auditing has evolved along with accounting. When the principles of reporting changed, the approaches to audits were also adjusted. For example, the transition to international financial reporting standards required new assessment methods from auditors. At the same time, professional judgment has always played an important role – this is when the auditor does not just compare the figures, but analyzes the situation as a whole, assessing the risks and prospects of the company. But since such a judgment is subjective, it is important to develop methods that will help make it more accurate.

Now the audit is going beyond the usual framework. Auditing is increasingly overlapping with other areas such as accounting, financial analysis, business management, and IT. This leads to the emergence of new types of audit and the need to clarify its classification. Now it is important not only to divide the audit into external and internal, but also to take into account the specifics of different types of audits, their goals and objectives. In general, auditing has long been more than just checking reports – it is becoming a tool for making managerial decisions. In order for it to remain relevant, it is necessary to take into account changes in the economy, apply digital technologies and develop new approaches to evaluating the activities of companies. The interrelation of information reflection concepts in accounting (financial) statements with audit paradigms is shown in Figure 1.

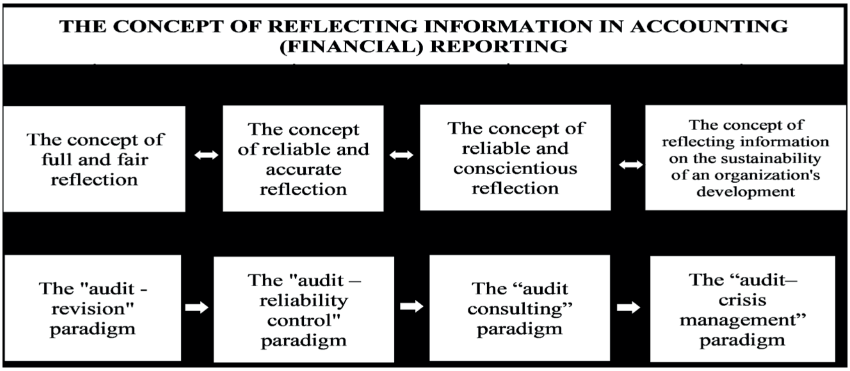

Figure 1 - The author's justification of the relationship between the concepts of information presentation in accounting (financial) statements and paradigms in auditing
Note: compiled based on data from (Mattei et al., 2021; Boudoukh et al., 2022)

This new concept of state audit is aimed at not just checking how well budget funds are being spent, but systematically assessing how effectively national resources are being used. The main ideas here are as follows:

- Balance between the needs of society and the budget possibilities. This means that the audit should take into account not only financial, but also social efficiency – that is, how much government spending really improves the lives of citizens. For example, it is important not only to check how much money has been spent on healthcare, but also to assess how much access to medical services has improved.

- Analysis of the contribution of government agencies to the economy. Government agencies and state-owned companies play an important role in the development of various industries. An audit should not only identify errors, but also help improve financial management so that money is spent with maximum benefit.

- Traditionally, the audit has focused on recording the facts of misuse of funds. However, the new model involves a shift in focus – it is important to analyze the reasons why problems arise and find ways to solve them before mistakes lead to a loss of budget funds.

- In many countries, the public audit system is developing according to similar principles, but each has its own successful practices. Kazakhstan strives to adapt the best international methods and implement them into its control system. This applies to both technologies and audit approaches.

An example of such a transformation is The Concept of State Audit implementation in Kazakhstan. This document sets out the key principles for reforming the control system and expanding audit functions so that it becomes not just a verification tool, but a mechanism that helps the state effectively manage finances (Systematic approach). To develop a new paradigm for the development of public audit, it is necessary, first of all, to carry out an effective assessment of the state and use of national resources and, in particular, natural resources. Accordingly, an important component is the assessment of the effectiveness of the use of natural resources (Decree). The Republic of Kazakhstan is one of the largest countries in the world by area and possesses vast natural resources, including oil, gas, uranium and rare metals. The effective use of these national resources plays a crucial role in the economic development of a country, its sustainability and global competitiveness. However, resource management requires a systematic approach that provides long-term benefits while minimizing environmental and economic risks.

Kazakhstan has significant oil reserves, which makes the country one of the key players in the Central Asian oil and gas industry. In terms of proven oil reserves, Kazakhstan ranks 9th in the world, owning approximately 4% of the world's hydrocarbon resources. There are about 180 oil and 45 condensate fields in the country, with most of them located in the western regions. The main reserves are concentrated in more than a dozen large fields, including Tengiz, Kashagan, Karachaganak, Uzen, Zhanazhol and Kalamkas. The history of oil production in Kazakhstan dates back to 1911. Kazakhstan ranks second among the former Soviet republics in terms of oil reserves and production, second only to Russia. There are also significant natural gas deposits in the country.

In the future, Kazakhstan may become one of the five largest oil producing countries in the world if the main fields are fully developed. There are three large oil refineries operating in Kazakhstan: Atyrau Refinery, Pavlodar Petrochemical Plant, Shymkent Refinery. These enterprises play an important role in providing the country with petroleum products. All three refineries are currently undergoing modernization aimed at increasing capacity and improving production efficiency. As in other countries, Kazakhstan's oil and gas sector faces both positive and negative factors. The industry is influenced by global oil prices, the geopolitical situation, the demand for energy resources and the development of new energy technologies. Kazakhstan's economy is heavily dependent on natural resources, especially oil and gas, which make up a significant portion of GDP and export earnings. The country is one of the world's largest uranium producers, making it a key player in the nuclear energy sector. Kazakhstan's natural resources belong to the state and are a key factor in economic development. They require effective management, as they play an important role in ensuring national welfare. In connection with the reform of the public administration system, the issue of introducing a new approach to natural resource management has become particularly relevant. For Kazakhstan, natural resources are not just an economic resource, but also a strategic priority that affects international cooperation, investment attractiveness, and foreign economic policy. They must be used efficiently and rationally to benefit both present and future generations.

Natural resource management must comply with modern standards of public administration, take into account the best international practices and regional peculiarities. This is especially true of the mineral resource complex, which is the basis of industrial production and contributes to the growth of the national economy.

Despite the significant potential, there are serious problems in this area that require prompt solutions.:

-Insufficient financing of geological exploration, which reduces the pace of discovery of new deposits.

- Outdated geological survey methods, which surveyed 80% of the database.
- Incomplete accounting of the components of deposits, which leads to irrational use of minerals.
- Limited use of new technologies, especially in the field of processing complex ores.
- Mismatch between extraction and replenishment of reserves, which jeopardizes the sustainability of the resource base.
- Weak control over the rational use of mineral resources due to the lack of qualified personnel and lack of technical equipment.
- Lack of an effective mechanism for monitoring the consumption and replenishment of mineral resources.
- Insufficient development of information and analytical systems, which makes accurate forecasting and effective planning difficult.
- Low level of digitalization of geological data and limited access to them.

- Unclear revenue sharing mechanism from the raw materials sector, which may reduce the transparency of resource management.
- Shortage of specialists in the field of environmental management and resource management.

Figure 2 illustrates the final energy consumption by fuel type from 2015 to 2023. The different colors represent different energy sources, including coal, oil and petroleum products, natural gas, biofuels/waste, electricity and thermal energy. Over the years, total energy consumption has gradually increased, with some fluctuations in specific fuel sources.

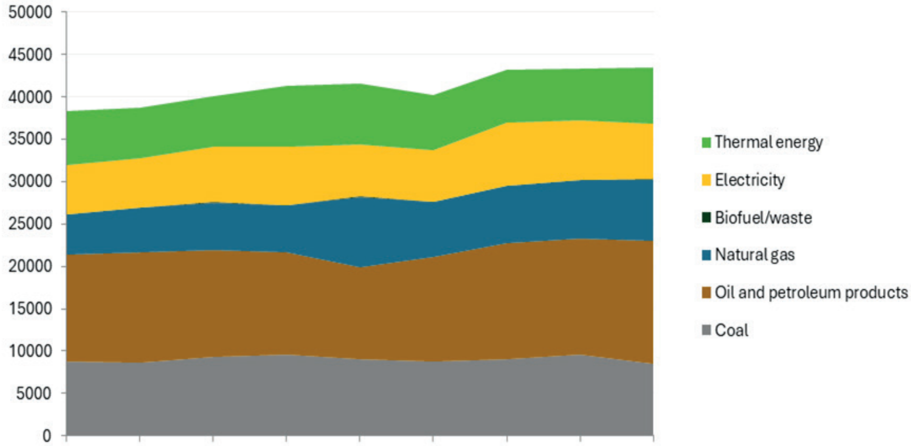

Figure 2 - Final energy consumption by fuel type
Note: compiled based on data from (Balance, 2023)

In 2023, oil and petroleum products accounted for the largest share of final energy consumption — 33.5%, followed by coal — 19.4%. Natural gas accounted for 16.7%, while electricity accounted for 15% of total consumption. Thermal energy accounted for 15.3%, with biofuels and waste accounting for the remainder.

The trend shows relatively stable consumption of fossil fuels with a slight increase in consumption of natural gas and electricity. Renewable sources such as biofuels/waste have also maintained a constant share. The overall increase in energy consumption implies an increase in demand due to economic growth, industrial expansion, and increased energy demand in various sectors.

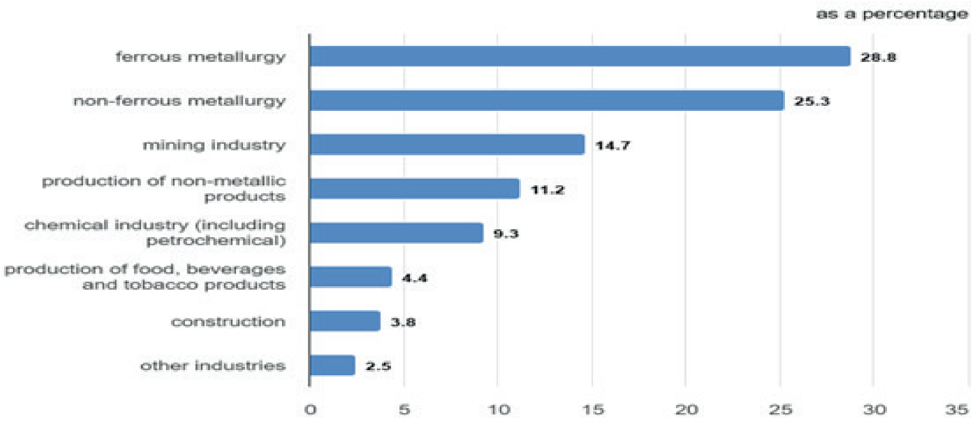

Figure 3 - Industrial final energy consumption by subsector in 2023
Note: compiled based on data from (Balance, 2023)

The largest share in the structure of final consumption of the industrial sector is occupied by ferrous metallurgy – 28.8%, non–ferrous metallurgy – 25.3% and mining industry - 14.7% of final consumption in the industrial sector. Ferrous metallurgy is the largest energy-intensive subsector, accounting for 28.8% of total industrial energy consumption. This is due to the high energy requirements in the smelting and refining of cast iron and steel. It is followed by non-ferrous metallurgy with 25.3%, which indicates significant energy consumption in the production of metals such as aluminum, copper and zinc. The mining industry consumes 14.7%, reflecting a significant need for energy for extraction and processing of raw materials. The production of non-metallic products such as cement, glass and ceramics accounts for 11.2% of industrial energy consumption. The chemical industry (including petrochemical production) consumes 9.3% of all industrial energy, which highlights the energy-intensive nature of chemical processing. The food, tobacco and beverage industries account for a smaller share – 4.4%, and construction – 3.8%, while both industries consume relatively less energy. Other industries collectively account for 2.5% of total industrial energy consumption.

In accordance with the directions of the WGISTA, the development of public audit in the Republic of Kazakhstan should focus on key developments in such areas as artificial intelligence, blockchain technologies, cybersecurity, data analysis, 5G cellular technologies, machine learning and quantum computing, which will also have an increasing impact on governments and auditors. This work is directly related to the understanding of the audited entity. The strategic objectives of the state audit bodies of the Republic of Kazakhstan should be aimed at:

- Close cooperation within INTOSAI and with leading external stakeholders;
- Conducting environmental analysis to identify key science and technology issues that will have an impact on governments and auditors;
- Assessment and exchange of best practices in monitoring government responses to advances in science and technology;

- Assessment and exchange of best practices in the development and maintenance of expert knowledge in SAIS and the application of science and technology in auditing activities;
- Identify the competencies required by SAIS and auditors to rapidly implement advances in science and technology;
- Strengthening cooperation between SAIS and other relevant organizations with common interests in this field; and
- Developing a database of experts or consultants that are available and can be used by INTOSAI members and regional organizations.

The existing paradigm in Kazakhstan remains largely financial and compliance-oriented, focusing on reporting and legal conformity. While these are essential, they are insufficient to evaluate strategic use of national resources, particularly in sectors like energy, minerals, and environmental protection.

The proposed paradigm includes the following components:

- Integration of performance, economy, efficiency, and effectiveness;
- Use of digital tools (AI, big data, GIS systems) for real-time monitoring;
- Audit of national resource management (including sustainability and ESG);
- Emphasis on transparency and public value;
- Cross-sectoral and forward-looking audit planning.

This shift represents a movement from financial audit to a strategic, resource-based audit that supports long-term development goals.

Kazakhstan's resource-based economy underscores the need to include national resource evaluation in the audit scope. However, current audit reports rarely cover performance or strategic impact in resource sectors. A resource-oriented audit approach can:

- Assess policy outcomes related to extraction and preservation;
- Analyze efficiency of resource allocation and royalties;
- Identify risks and long-term sustainability challenges.

Conclusion

The article proposes, for the first time, a model of public audit that incorporates strategic assessment of national resources through the use of digital technologies. This reflects a shift from financial and legal conformity to a broader governance-supporting function of audit institutions. The new paradigm may guide Kazakhstan's reform of state audit institutions. It provides a foundation for incorporating international best practices in performance auditing and integrating natural resource oversight into public financial management. A new paradigm of public audit in Kazakhstan should reflect modern governance priorities: digital transformation, sustainability, and strategic resource use. The integration of these elements will strengthen the role of audit institutions in ensuring national development and public trust.

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